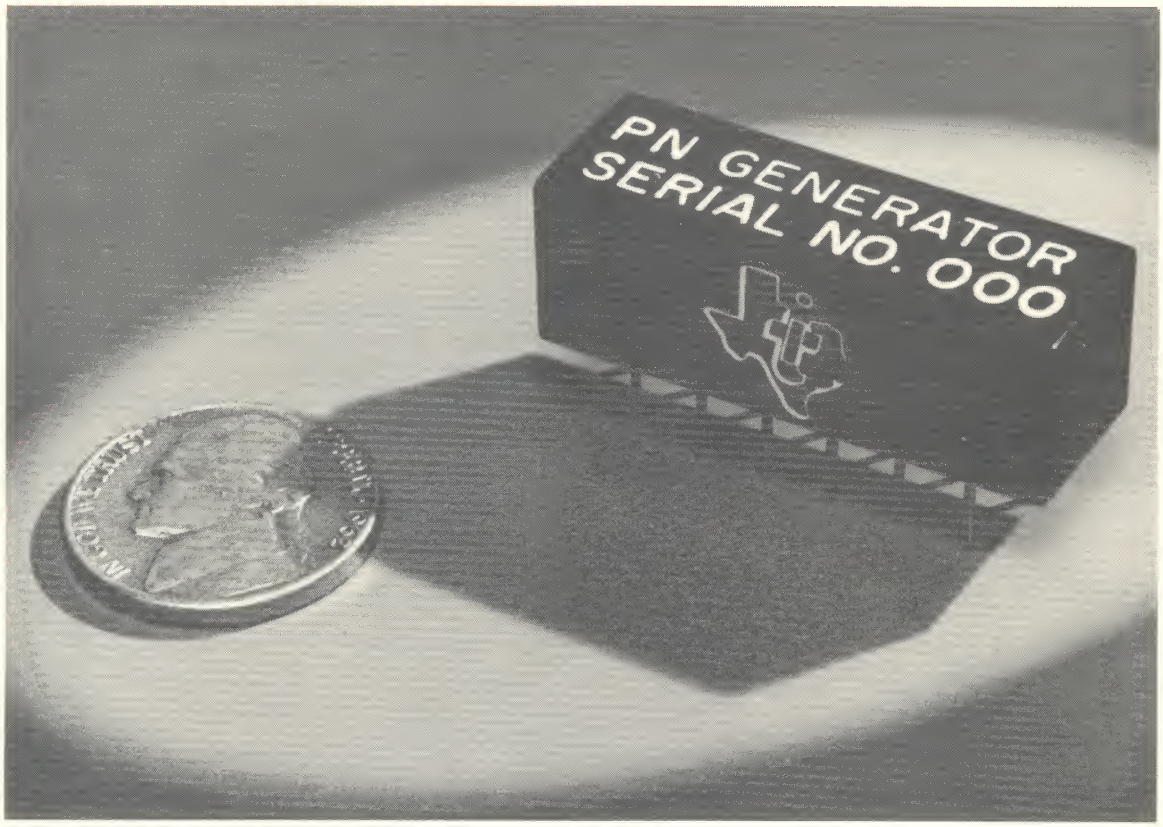
PSEUDONOISE GENERATOR
For Missile/Space Vehicle Applications

BULLETIN NO. DLA-1291, FEBRUARY 1963



Texas Instruments Pseudonoise Generator, built under contract to Jet Propulsion Laboratory of the California Institute of Technology, contains 23 SOLID CIRCUIT* semiconductor networks. The unit shown generates a 63-bit pseudorandom code with ten various code positions selected as outputs.

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apparatus division
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INCORPORATED
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SPECIFICATIONS

input characteristics

Type	Clock pulse
Amplitude	4 volts
Fall time	Less than 0.5 microsecond
Width	2 microseconds
Repitition frequency	100 kilocycles

output characteristics

Signals	(1) 63-bit pseudonoise code (2) Every 9th PN generator state decoded for bit sync output (3) One state of every cycle decoded for word sync output (4) 7 consecutive states decoded individually to provide pulses for driving an ADC
Amplitude	All pulses 4.0 volts minimum amplitude

physical characteristics

Size	0.375 cubic inch
Weight	10 grams
Power	60 milliwatts

environmental specifications

Temperature	— 55°C to + 85°C
Shock	200g for 0.5 to 1.5 milliseconds
Vibration	Complex wave — standard tape 15g rms noise for 6 seconds 10g rms noise for 180 seconds 4.5g rms noise for 360 seconds 4.5g sinusoidal for 360 seconds 15g sinusoidal for 6 seconds
Static acceleration	15g for 5 minutes

DLA-1291, FEBRUARY 1963

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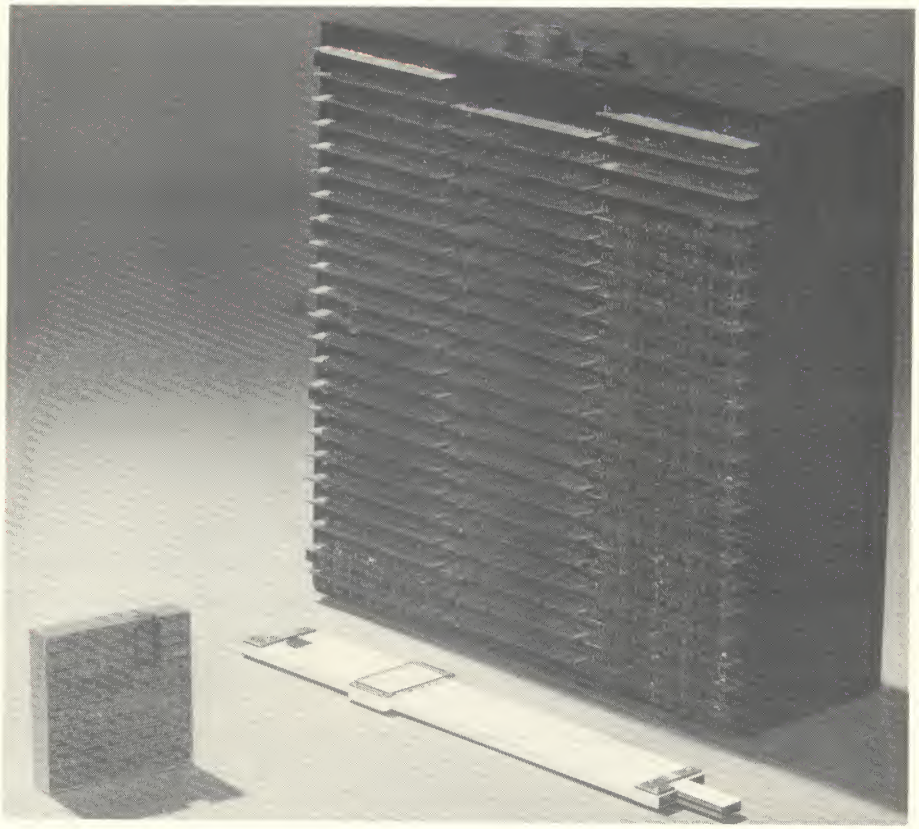
BULLETIN NO. DLA-1295, JUNE 1963

DEMONSTRATION COMPUTER
Using Semiconductor Networks



The Tiny Computer on the left is dwarfed by a transistorized conventional computer which has identical functions. The computer was delivered to the Aeronautical Systems Division of the U. S. Air Force in 1961 as a demonstration device for ASD's Molecular Electronics Program. It was the world's first practical working equipment built entirely of integrated circuits.

Packaged in 6.3 cubic inches and weighing 10 ounces, the computer has 587 SOLID CIRCUIT* semiconductor networks. The equivalent conventional computer has 8500 components.

The computer is a serial, synchronous, binary, fixed-point machine with an operand word length of 10 bits, plus sign. There are 32 words of memory: 16 words for operand storage and 16 words for instruction storage. For demonstration purposes it has been programmed to simulate a desk calculator, using a manual control unit for communication between operator and computer.

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SPECIFICATIONS

input characteristics

Power	+10 VDC +6 VDC
Clock pulses	200 KC, 4 volts, 2 microseconds wide
Data	4 volts amplitude, synchronized with clock (input is to accumulator)

output characteristics

Data	4 volts amplitude, synchronized with clock (output is from accumulator)

physical characteristics

Weight	10 ounces
Size	6.3 cubic inches
Power dissipation	16 watts (High heat loss due to use of preproduction semiconductor networks. Identical unit built today with production line Series 51 SOLID CIRCUIT semiconductor networks would use less than 1 watt).

environmental characteristics

Built only for ordinary laboratory and demonstration use.

DLA-1295, JUNE 1963

apparatus division

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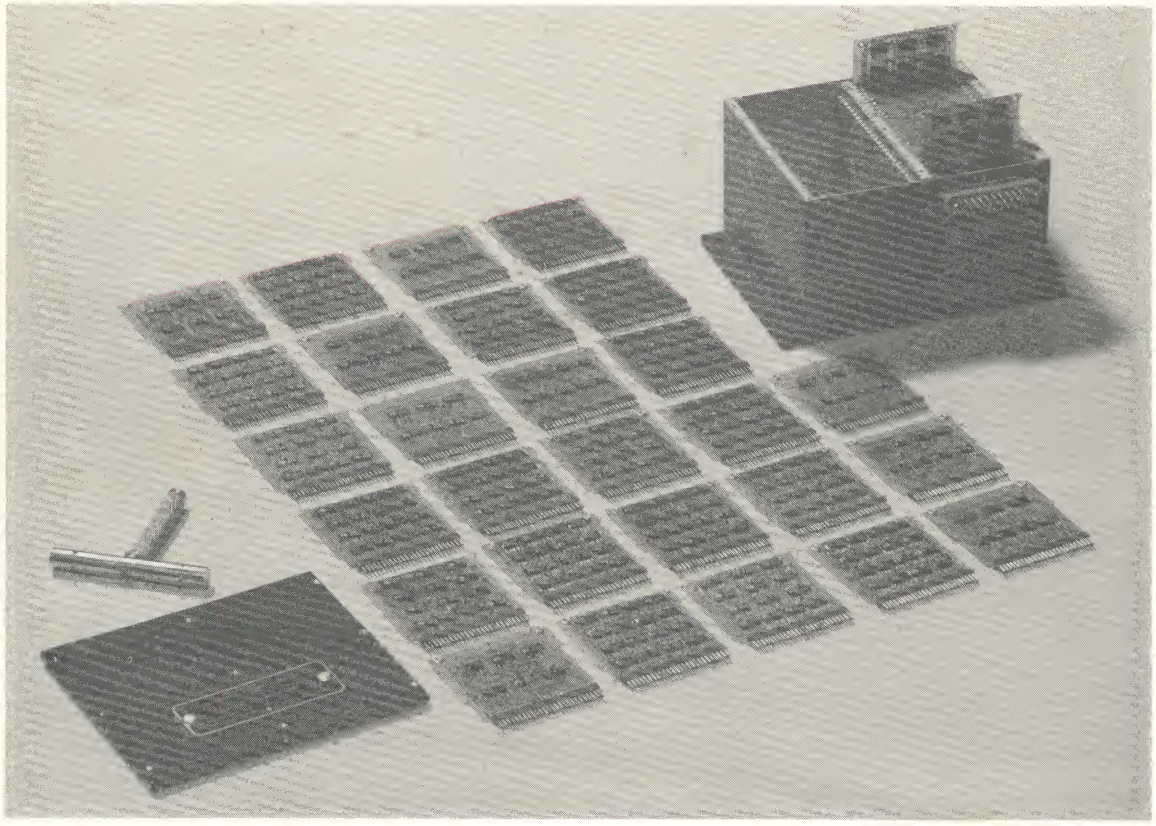
BULLETIN NO. DLA-1294, FEBRUARY 1963

ARITHMETIC UNIT
For Missile/Space Vehicle Applications



The Tercom Arithmetic Unit contains 542 SOLID CIRCUIT* semiconductor networks packaged in a manner similar to conventional components on 49 etched boards.

Key features are the extensive use of welded connections throughout and the application of integrated circuitry to achieve an estimated system MTBF of 1970 hours.

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SPECIFICATIONS

physical characteristics

Size	21.7 cubic inches 3.376 x 2.986 x 2.146 inches
Weight	17 ounces
Power	+ 4.5 volts 3.7 watts

environmental specifications

	Meets MIL-E-5400 Class II requirements
Temperature	—54°C to + 71°C
Shock	15g for 5.5 milliseconds
Vibration	5-10 cps, ± 0.080-inch DA 10-15 cps, ± 0.42g sinusoidal 15-75 cps, ± 0.036-inch DA 75-500 cps, ± 10g sinusoidal

DLA-1294, FEBRUARY 1963

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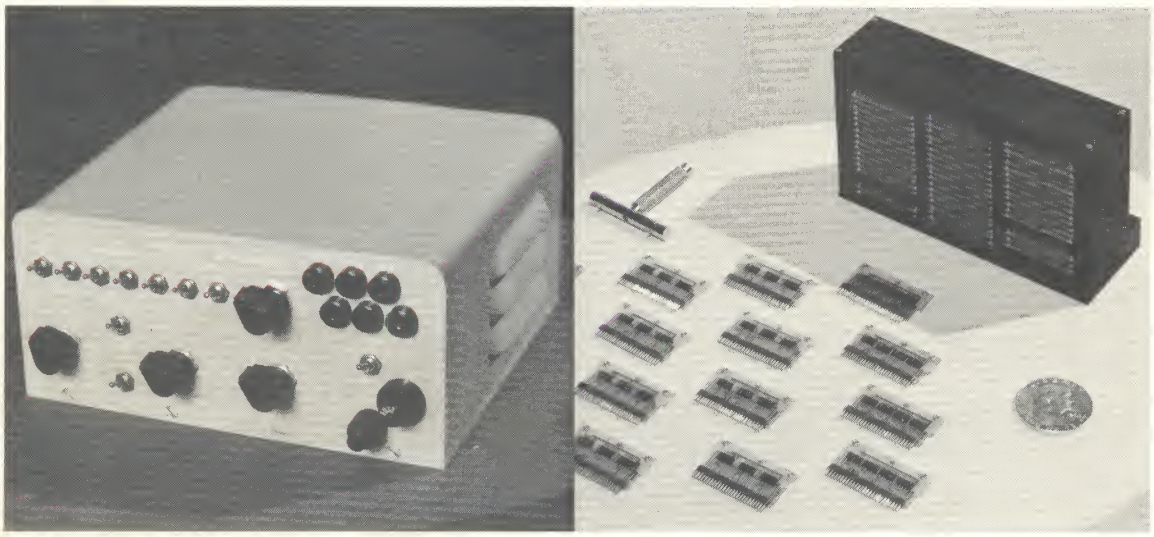
SPACECRAFT ENCODER SIMULATOR
For Operational Support Equipment Checkout

BULLETIN NO. DLA-1296, REV. A, AUGUST 1963



Complete assembly is 7 inches wide and 3.25 inches high.
Photo on right shows the logic module, built entirely of SOLID CIRCUIT* semiconductor networks.

The Spacecraft Encoder Simulator functionally duplicates the spacecraft encoder, enabling complete evaluation of the Operational Support Equipment.

The simulator logic is designed with 200 SOLID CIRCUIT semiconductor networks (Series 51), packaged on printed circuit cards. Sixty-seven of these cards are contained in a rectangular package 6.0 x 4.5 x 1.5 inches. The network package weighs 2 pounds, and consumes 1.4 watts, answering an often-encountered problem — the requirement for complex logic functions where power and space are at a premium.

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SPECIFICATIONS

input characteristics

Clock rate	387.072 kc signal from controlled oscillator
Data input	Switches for internal control or external NRZ data input for secondary applications

output characteristics

Mixed signal	Pseudo-random auto-correlation code, half-added with NRZ data, half-added with the code clock frequency
Modes	Four data modes, five operational modes, manually selected (identical to those in the spacecraft being simulated)
Data	Binary code, 7-bit words
Synchronization	Bit and word syncs are derived from the pseudo-random auto-correlation code, and duplicate the timing synchronization of the spacecraft
Bit rates	5.25 to 10,752 bps, in 11 steps
Format data sequence	1st word — frame sync 2nd word — data mode and rate data deck position 3rd to 7th word — subcom decks 1 through 5 8th to 48th word — binary numbers according to preset program
Ground	For common system operation with Operational Support Equipment

physical characteristics

Weight	2 pounds (network package) 6 pounds (complete package)
Size	6.0 x 4.5 x 1.5 inches (network package) 7.02 x 6.69 x 3.25 inches (complete package)
Power dissipation	1.4 watts maximum (6-volt supply)

DLA-1296, AUGUST 1963

apparatus division

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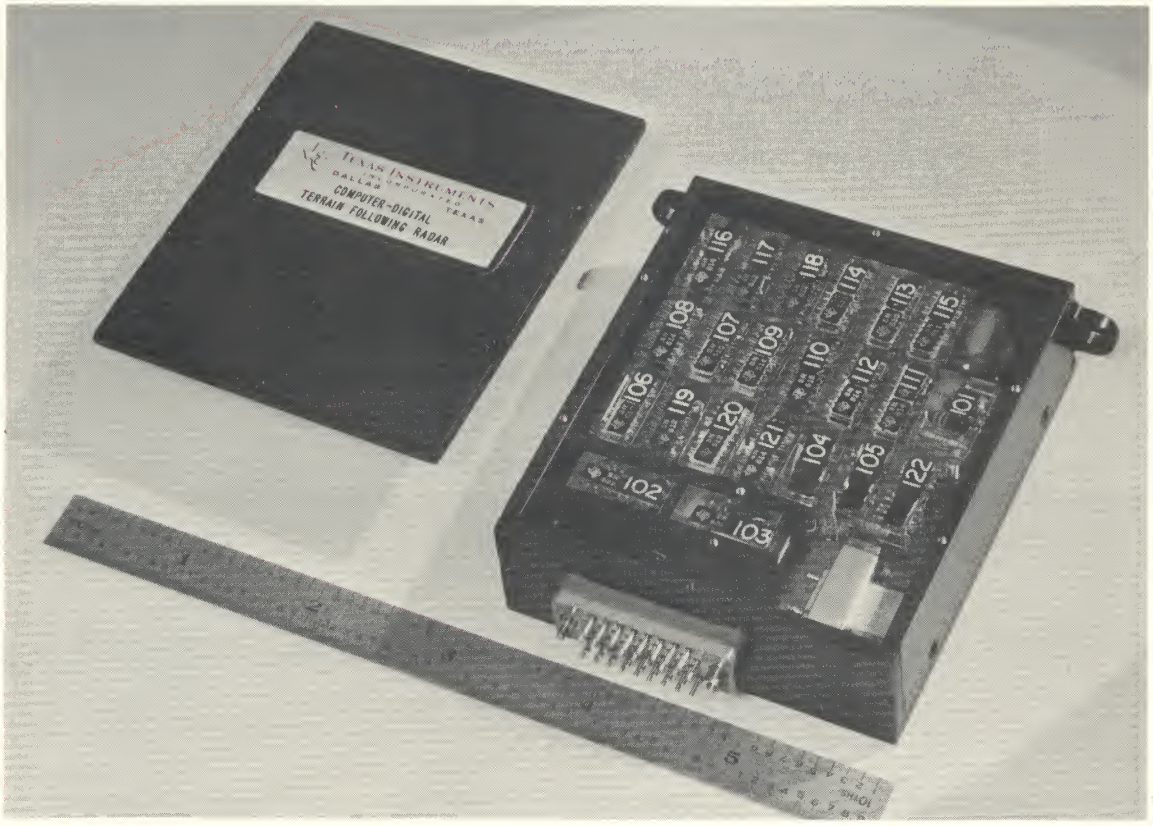
BULLETIN NO. DLA-1299, AUGUST 1963

RADAR COMPUTER
For Automatic Terrain-Following Computations



This 12-ounce computer provides timing, ranging, flight command computing and self-check functions for a prototype airborne radar subsystem (automatic low-altitude terrain-following radar).

Sophisticated digital correlation techniques, and extensive fail-safe provisions are made possible by the versatility and size advantages of SOLID CIRCUIT* semiconductor networks. Circuitry includes 193 digital networks (Series 51), 6 linear networks (Series 52), and 18 custom high-speed digital networks. 108 conventional components are used, primarily in the A/D and D/A converters. Design goal of the computer is 3300 hours mtbf.

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SPECIFICATIONS

inputs

Analog voltage representing desired slant range
Pulse in time representing actual slant range

outputs

Proportional climb-dive flight command, analog and digital
Range to target, digital
Display range marks
PRF timing pulses
Receiver-computer fail signal

physical characteristics

Size	3.265 x 2.72 x 1.0 inches
Weight	0.75 pound
Power	1.5 watts

environmental characteristics

Class II Aircraft, MIL-E-5400

DLA-1299, AUGUST 1963

apparatus division

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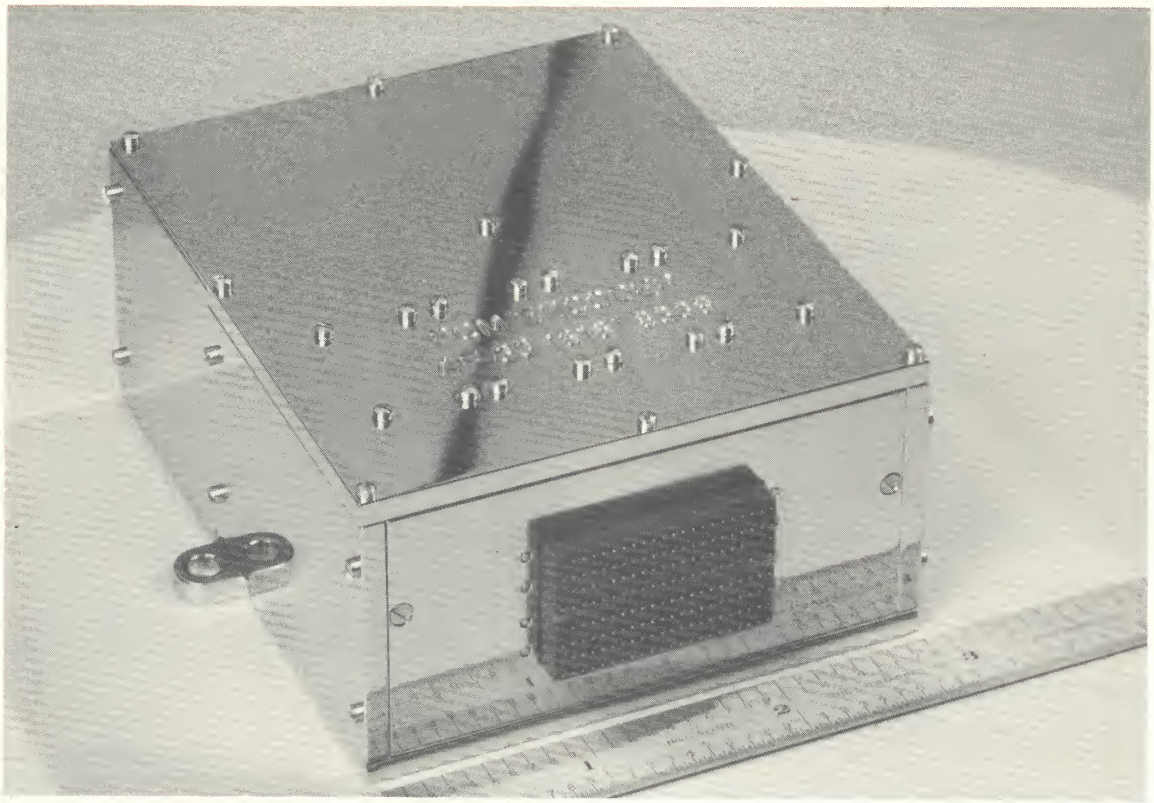
PCM ENCODER
For Space Telemetry Applications

BULLETIN NO. DLA-1298, AUGUST 1963



This PCM Encoder was built for WADC on Contract No. AF 33(616)-8339. It is interchangeable with a conventional solid-state unit that weighs 50 times as much and occupies 100 times the space. It includes 358 SOLID CIRCUIT* semiconductor networks of both digital and linear types.

Twenty-one input channels are provided, 16 analog and 5 digital. Each channel consists of 8 bits of information and 2 bits of word sync. A 22nd channel provides 10-bit frame sync. Output is an NRZ pulse train at a 200-kc bit rate in both Gray and binary code.

Analog channels are both low-level differential (0 to 1 mv, 0 to 10 mv, 0 to 50 mv and 0 to 100 mv) and high-level single-ended (0 to 5 v). Each channel has its own signal conditioning amplifier allowing high-level multiplexing to the ADC. The ADC is an 8-bit asynchronous cyclic type.

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SPECIFICATIONS

input characteristics

Channel 1	0-1 mv differential
Channels 2-4	0-10 mv differential
Channels 5-8	0-50 mv differential
Channels 9-12	0-100 mv differential
Channels 13-16	0-5 volts single-ended

output characteristics

Serial NRZ	At 200-kc bit rate
Output A	Gray code
Output B	Binary code

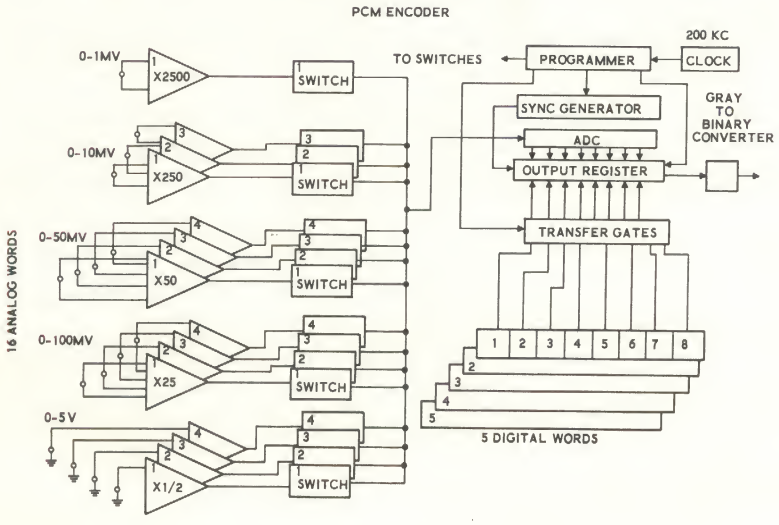
physical characteristics

Size	3.41 x 2.87 x 1.56 inches
Weight	1.5 pounds
Power	6 watts electronics
	6 watts temperature stabilization at 25°C

environmental characteristics

Class II Aircraft, MIL-E-5400.

BLOCK DIAGRAM



FORMAT

		b1	b2	b3	b4	b5	b6	b7	b8	b9	b10
ANALOG CHANNELS	W1									1	0
	W2									1	0
	W3									1	0
	W4									1	0
	W5									1	0
	W6									1	0
	W7									1	0
	W8									1	0
	W9									1	0
	W10									1	0
	W11									1	0
	W12									1	0
	W13									1	0
	W14									1	0
	W15									1	0
	W16									1	0
DIGITAL CHANNELS	W17									1	0
	W18									1	0
	W19									1	0
	W20									1	0
	W21									1	0
FRAME SYNC	W22	1	0	0	0	0	1	1	1	0	1

DLA-1298, AUGUST 1963

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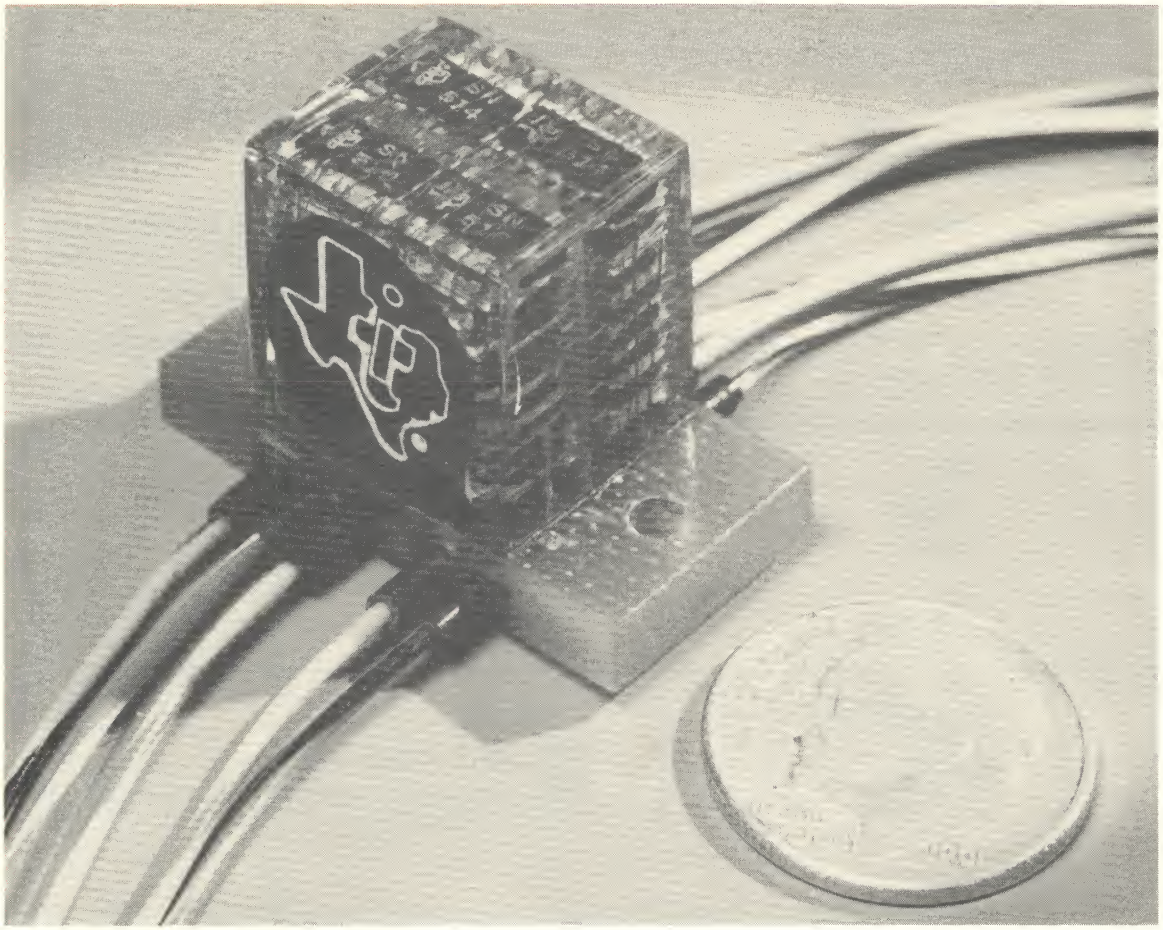
COUNTER-SCANNER-PROGRAMMER
For Missile/Space Vehicle Applications

BULLETIN NO. DLA-1292, FEBRUARY 1963



Texas Instruments Counter-Scanner-Programmer is an evaluation device built under contract to the National Aeronautics and Space Administration. Its intended use is in a space vehicle payload. The equipment uses 36 SOLID CIRCUIT* semiconductor networks packaged in a stacked, modular configuration.

The equipment counts input pulses and, on command, scans the counter and delivers an output in the form of a 12-bit serial NRZ pulse train. The output can start a second counter. It also provides a signal with the most significant bit for synchronization purposes.

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input characteristics

Input signal	Asynchronous pulses
Start input	System will readout or scan the contents of a 12-bit counter upon command

output characteristics

Signal	12-bit NRZ pulse train—most significant bit first
Sync	A synchronizing pulse is supplied at the same time as the most significant bit.

Provisions are available for supplying a "START" command to another counter at the conclusion of the scan.

physical characteristics

Size	0.3 cubic inch
Weight	12.8 grams
Power	48 milliwatts standby 75 milliwatts operate
Voltage	+ 3 volts

environmental specifications

Temperature	— 10°C to +85°C
Shock	100g for 6 milliseconds
Vibration	14g rms random noise on 5g sinusoidal from 20 to 2000 cps

DLA-1292, FEBRUARY 1963

apparatus division

TEXAS INSTRUMENTS
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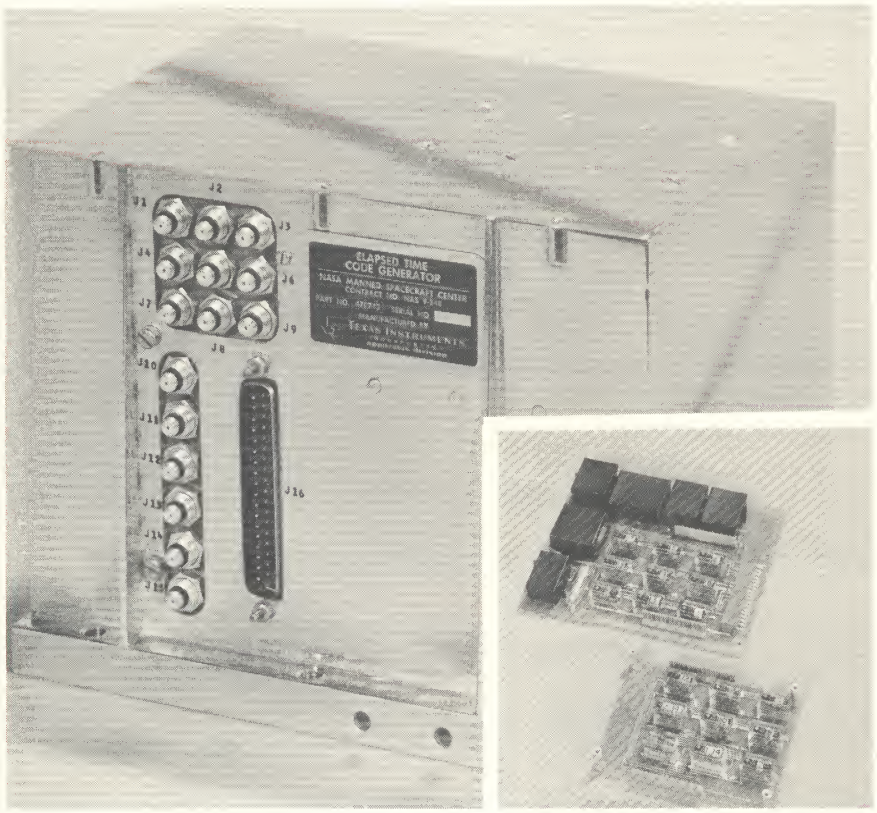
BULLETIN NO. DLA-1297, AUGUST 1963

ELAPSED-TIME CODE GENERATOR
For Manned Space Flight Application



An accurate elapsed time serial-code is the primary output of this equipment built by Texas Instruments on contract to NASA. Its capacity is from t = 0 to a maximum of 16 days 23 hours 59 minutes and 59 seconds. Every 10 seconds a five-volt 150-millisecond square-wave frame sync pulse is generated. Every second a similar 50-millisecond bit sync pulse is generated. The elapsed-time code pulses occur between the one-second timing pulses.

For reliability and space economy, SOLID CIRCUIT* semiconductor networks are used for all time accumulator circuitry. Network logic elements are assembled in welded encapsulated modules. Amplifiers, filters, and high-speed logic elements consist of standard miniature welded components in encapsulated modules, mounted on plug-in printed circuit boards.

Controls include start and stop (automatic reset to t = 0) and provisions for advancing or retarding the accumulator in 10 or 100-microsecond increments for alignment of the generator to a primary time standard such as radio station WWV.

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SPECIFICATIONS

input characteristics

Power	28 VDC, 1.2 amps

isolated output signals

Signal	*Harmonic Distortion*	*Load Impedance*
2 — 512 kc 10V pp sinewave	< 1%	1000 ohms
4 — 100 kc 1V rms sinewave	< 1%	50 ohms
4 — 50 kc 1V rms sinewave	< 1%	50 ohms
4 — 25 kc 1V rms sinewave	< 1%	50 ohms
1 — 1 mc sinewave monitor		0.5 megohm
1 — 1 pps 5V square wave monitor		0.5 megohm
5 — Time Code, 5V square wave		0.5 megohm

physical characteristics

Weight	7.5 pounds
Size	6.90 x 5.26 x 5.45 inches
Power dissipation	33 watts including crystal oven

environmental characteristics

Shock	50 g for 11 milliseconds
Acceleration	20 g in each direction of each axis for 5 minutes
Altitude	10^{-7} mm of Hg
Temperature	−35°C to + 65°C with 10 minutes at + 110°C
Vibration	10 g from 10 to 2000 cps for 5 minutes in each major axis
Accuracy	1×10^{-7} parts for 48 hours after ½ hour warmup

DLA-1297, AUGUST 1963

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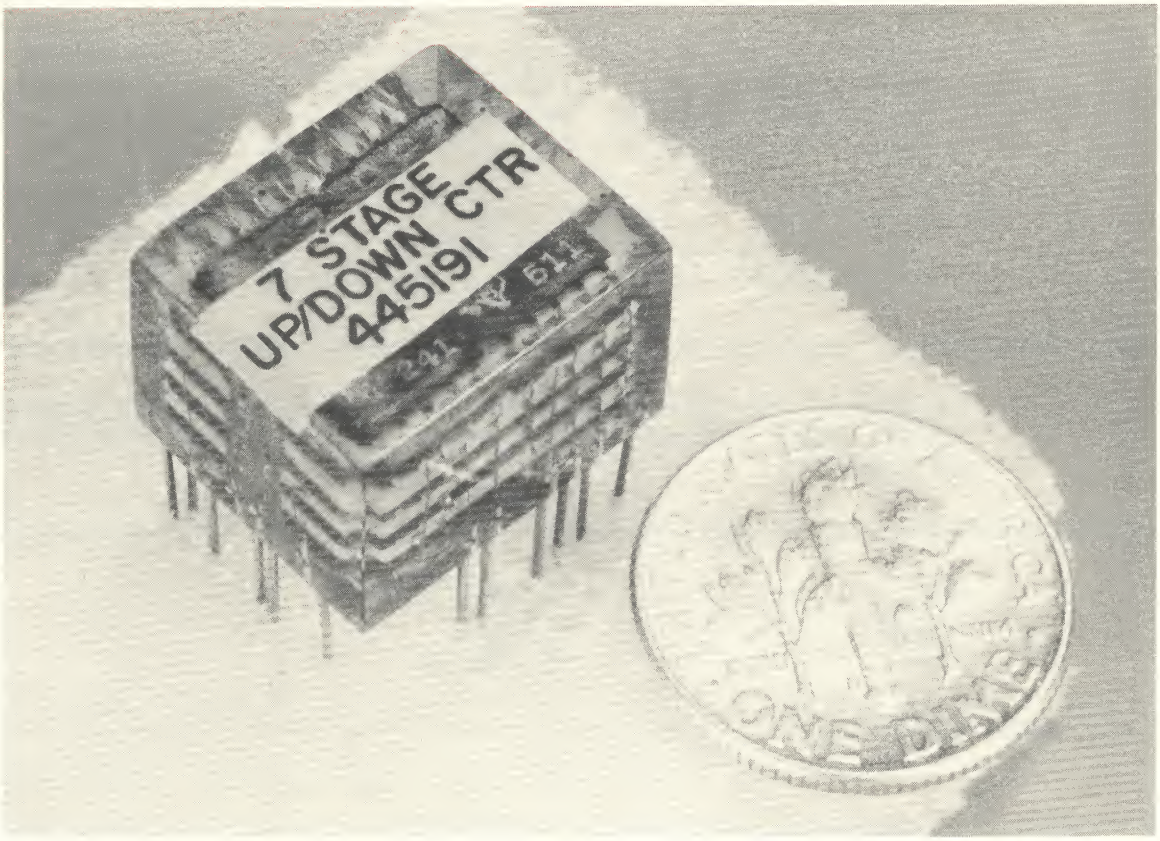
BULLETIN NO. DLA-1293, FEBRUARY 1963

UP/DOWN COUNTER
For Missile/Space Vehicle Applications



One of three types of counters delivered to NASA Huntsville, the seven-stage up/down binary counter contains 16 SOLID CIRCUIT* semiconductor networks. A stacked-module packaging technique is used in this unit.

Purpose of the counter is to keep a running tally of pulses occurring on either of two inputs. Pulses on one input are assigned a value of plus one, while pulses on the other input are assigned a value of minus one. As an alternative the counter can accept all pulses on one input while the plus or minus assignment is controlled by a second input.

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SPECIFICATIONS

input characteristics

Pulse inputs	
Swing	0 volt to + 2 volts
Input impedance	10 kilohms minimum
Unidirectional count prf	500 kilocycles
Bidirectional count prf	100 kilocycles
Preset input	
Preset voltage	+ 2 volts
Input impedance	2.8 kilohms
Preset duration	2 microseconds minimum

output characteristics

Q and Q of each counter stage are provided. Outputs are emitter follower circuits capable of driving 1 kilohm loads with a voltage swing of 0 volt to 3.8 volts.

physical characteristics

Size	0.12 cubic inch
Weight	8 grams
Power	25 milliwatts

environmental specifications

	(To customer flight equipment environmental specification)
Temperature	— 55°C to + 85°C
Shock	200g for 0.5 to 1.5 milliseconds
Vibration	Complex wave — standard tape 15g rms noise for 6 seconds 10g rms noise for 180 seconds 4.5g rms noise for 360 seconds 4.5g sinusoidal for 360 seconds 15g sinusoidal for 6 seconds
Static acceleration	14g for 5 minutes

DLA-1293, FEBRUARY 1963

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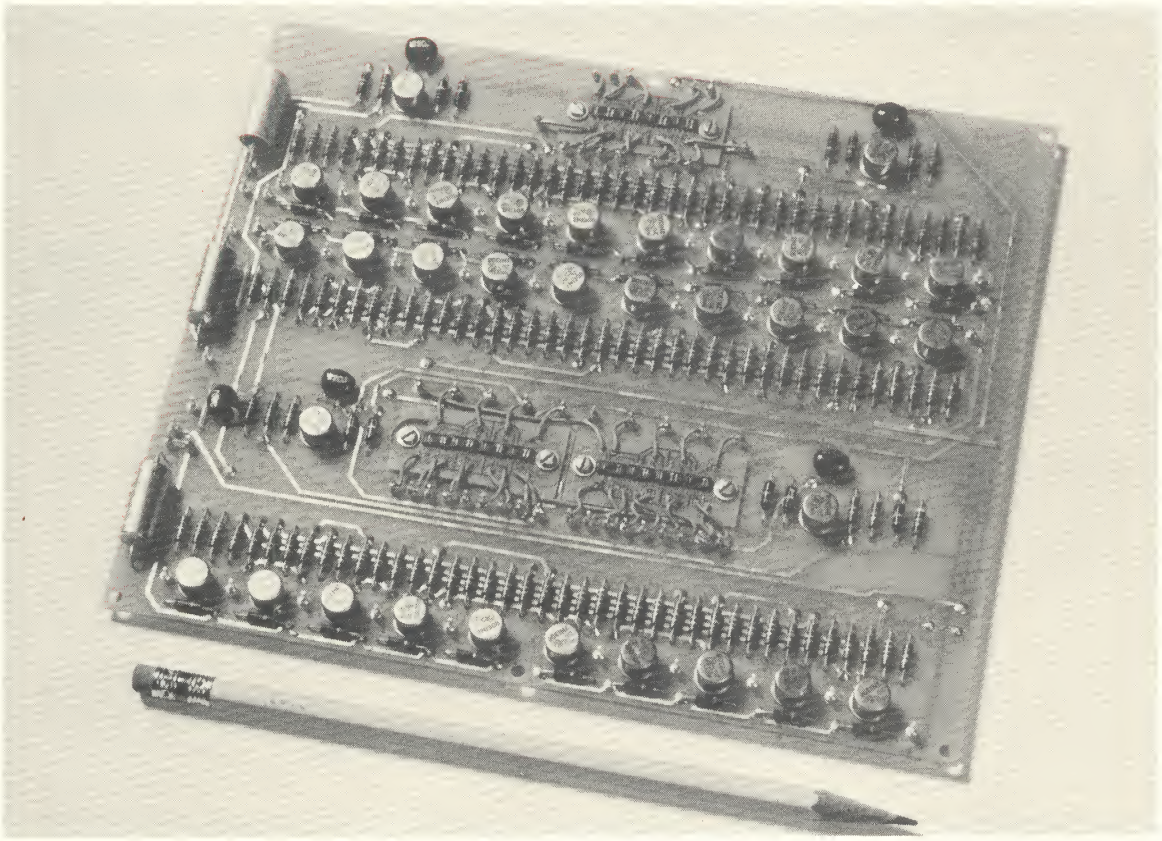
DECADE RIPPLE COUNTERS
Using Semiconductor Networks

BULLETIN NO. DLA-1290, FEBRUARY 1963



SOLID CIRCUIT* Semiconductor Networks were chosen for the decade ripple counters in the switching time test set module shown above. The units are being built for ground-based test equipment. An 8-inch by 8-inch printed circuit board is sufficient for the entire unit. There are three decade counters containing four semiconductor networks on each board. Each counter is completely decoded into ten output lines with transistor-resistor logic.

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SPECIFICATIONS

input characteristics

Input signal	100 KC pulse burst from a sampling measurement
Reset signal	Prior to receiving pulse burst, the counter is reset by this signal

output characteristics

The boards are made in two configurations. One configuration has its output lines compared with a limit switch bank in a "go" "no-go" type of test. The other configuration has its Nixie tubes for a direct digital readout of the counter contents, i.e., number of pulses in the pulse burst.

DLA-1290, FEBRUARY 1963

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TEXAS INSTRUMENTS
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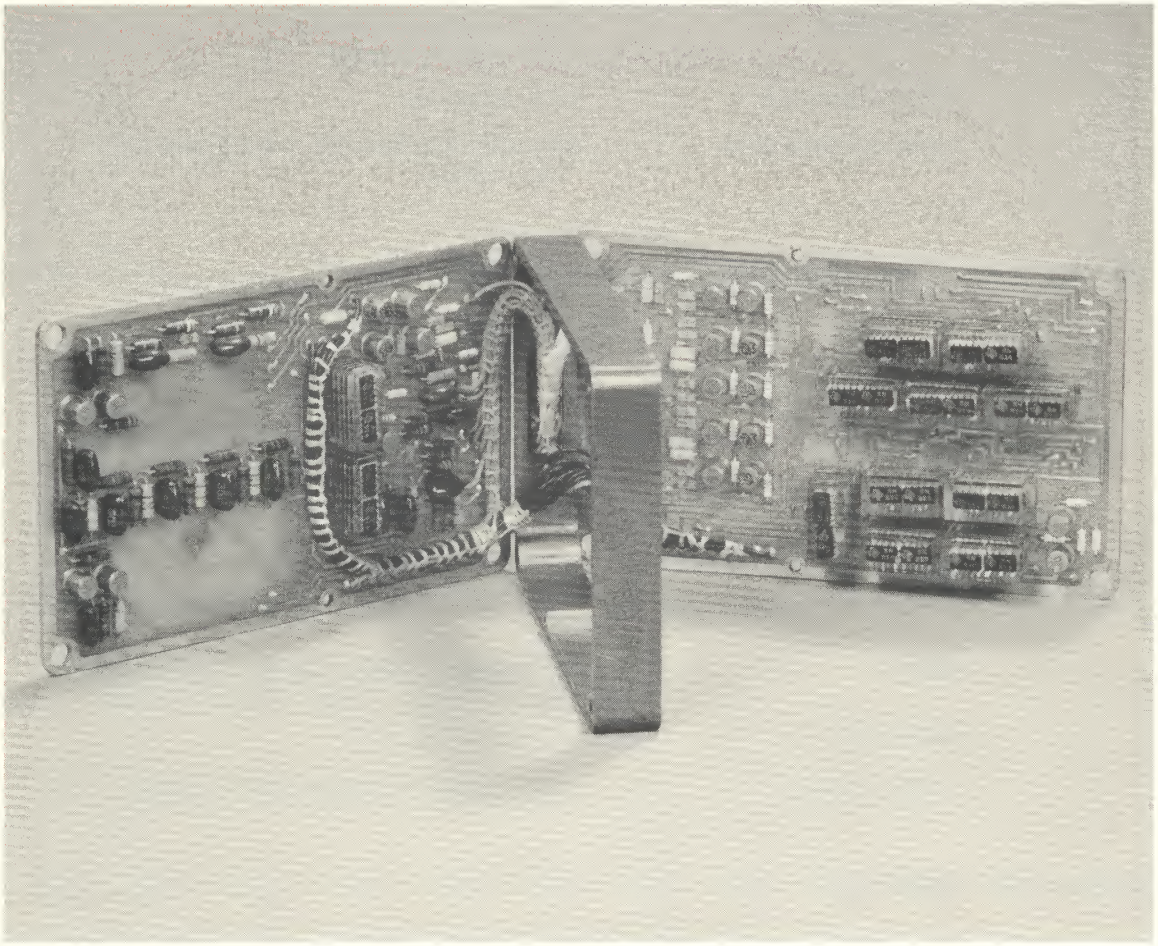
BULLETIN NO. DLA-1280, AUGUST 1962

Digital Data Signal Conditioner
FOR MISSILE/SPACE VEHICLE APPLICATIONS



Key feature of Texas Instruments digital data signal conditioner is the application of integrated circuitry to perform all of the logic in the subsystem. A total of 102 networks are used to give a semiconductor network equivalent of 2215 components in the seven-ounce package.

The equipment counts asynchronous pulses, generates parity, and formats the information for transmission as digital words on command from a central telemetry system. Eight Geiger Mueller tube outputs are sequentially sampled. The pulses are counted in a binary counter and transferred into a shift register in parallel, with parity bits added by a separate parity generator.

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SPECIFICATIONS

input characteristics

Number of inputs	8
Input signal	Asynchronous pulses
Input pulses	2 - 5 microsecond duration 0 - 40 volts amplitude
Input impedance	50 K minimum
Level discrimination	All pulses less than 3 V $\pm$ 0.2 V will not be counted

counting interval for each input

Externally controlled

count capacity

32,768 counts per channel

output characteristics

Signal	NRZ binary 16-bit words read out serially on command (includes odd parity bit)
Amplitude	6 volts peak-to-peak
Output bit rate	64 kc maximum externally controlled

physical characteristics

Weight	7 ounces
Dimensions	4.5 x 2.75 x 0.90 inches

power

+3 and +6 volts,
dissipates 280 milliwatts

DLA-1280, AUGUST 1962

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